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ABSTRACT

The purpose of this study was to develop and try out an activity in a group of 10 inservice teachers enrolled in a professional development program. A science methods instructor designed an activity based on a learning cycle teaching approach. In the activity, the teachers experienced the social constructing of knowledge and were promoted to a better understanding about the philosophy of science. The influence of learners' preconceptions in science teaching and learning was also explored. The inservice teachers showed a positive attitude toward this instructional strategy. They agreed on the importance of the learners' preconceptions in learning science. However, they argued that time limitation and the way the textbook was edited were barriers for them to adopt constructivist teaching approaches. The teachers with a better understanding about the epistemological status of the scientific knowledge, were more willing to incorporate history of science and group discussion into their teaching. In a survey conducted 4 months after the classes, the teachers described constructivism in terms of: (1) the importance of learners' preconceptions in science teaching; (2) learning is an active process; (3) learning involves conceptual change; and (4) knowledge is tentative and subject to change. Contains 10 references. (Author/MKR)

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# INTRODUCING PHILOSOPHY OF SCIENCE THROUGH AN ACTIVITY FOR IN-SERVICE TEACHERS TO EXPERIENCE SOCIAL CONSTRUCTING OF KNOWLEDGE

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## ABSTRACT

The purpose of this study was to develop and try out an activity in a group of ten in-service teachers enrolled in a professional development program. Owing to the lack of a good understandings about the epistemological status of scientific knowledge the teachers showed in group discussions, the researcher, being the science methods instructor, designed an activity based on a learning cycle teaching approach. In the activity, the teachers experienced the social constructing of knowledge and were promoted to a better understanding about the philosophy of science. The influence of learners' preconceptions in science teaching and learning was also explored. The in-service teachers showed a positive attitude toward this instructional strategy. They agreed the importance of the learners' preconceptions in learning science. However, they argued that time limitation and the way the textbook being edited were barriers for them to adopt constructivist teaching approaches. The teachers with a better understanding about the epistemological status of the scientific knowledge, are more willing to incorporate history of science and group discussion into their teaching. Besides, the teachers mainly described the Constructivism in terms of (1) the importance of learners' preconceptions in science teaching, (2) learning is an active process, (3) learning involves conceptual change, and (4) knowledge is tentative and subject to change in a survey conducted four months after the classes.

**Paper will be presented in the 1996 NARST Conference held in St. Louis, U.S.A.**

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## SIGNIFICANCE

Hsu & Guo (1993) investigated Taiwanese junior high school science teachers' views about the philosophy of science and found that the science teachers' views mostly consistent with those of logical positivism. Gallagher (1991) investigated prospective and practicing secondary science teachers' knowledge and beliefs about the philosophy of science. He argued that science teachers are greatly responsible for the public image of science, and suggested that science teachers should discard the distorted understandings of the nature of science and the corresponding science teaching approaches. King (1991) reported that beginning science teachers with few or no background in philosophy of science have difficulties in incorporating ideas such as inquiry, discovery, relevance, and critical and creative thought into their teaching. King claimed that science teachers should not only learn science but also learn about science. The in-service teachers in our professional development program used to present science as a body of revealed truth and seldom or never considered the developing nature of scientific knowledge. Therefore, the researcher designed an activity to provide the in-service teachers an opportunity to experience the social constructing of knowledge and to help them understand the epistemological status of scientific knowledge.

## THEORETICAL UNDERPINNINGS

Under the prevailing constructivist trend in science education, science educators try to reform science teacher education curricula with regard to the constructivist epistemology. Shymansky (1992) pointed out that the dominating didactic methods used in science methods courses are in conflict with the constructivist view of learning.

Teachers have preconceptions about teaching and the preconceptions are hardly to change. Summer (1982) argued that the epistemology of science should be an essential component of science teacher education curriculum. One of his reasons is that a teacher's understanding about the philosophy of science influences how she or he teaches. Some following researches suggested (1) the developing process of scientific knowledge rather than the accepted results should be core of science curriculum (Abimbola, 1983), (2) the science teachers should model the flexible and non-static nature of scientific knowledge in their teaching (Burbules & Linn, 1991), (3) the science teachers' view of science and science teaching determine how effectively the teachers accommodate certain teaching strategies into teaching practice (King, 1991). Cobern (1991) described a game for introducing teachers to philosophy of science and promoted more design and application to direct science teachers. Karplus developed a learning cycle strategy that includes three facets: concept exploration, concept introduction, and concept application. The learning cycle approach has been broadly used to design activities of science teacher preservice and inservice education (Glasson & Lalik, 1993). On the basis of the research results described above, the researcher tried to apply learning cycle teaching approach in designing an introductory activity (Barman & Shedd, 1992) for the enrolled in-service teachers in learning philosophy of science.

## DESIGN AND PROCEDURES

Ten practicing teachers enrolled in an in-service professional development program in 1994-95 showed few backgrounds in the philosophy of science. In the science methods course, the teachers initiated an activity of

watching taped microteaching classes to learn instructional strategies from other science teachers' teaching. The researcher, as science methods instructor, designed an introductory activity for the teachers to examine their criteria for a good science teaching and experience social constructing of knowledge at the same time.

I. the concept exploration phase:

The researcher selected five tapes of microteaching sessions and sequenced them based on the teaching strategies involved. The teaching strategy(ies) involved were lecturing (two tapes), lecturing with a cooperative learning format (one tape), task-centered problem solving (one tape), and a mix of all kinds of instructional strategies mentioned combining audio-visual media (one tape).

Each tape-watching session lasted for about 25 minutes. At the first three tape-watching sessions, there were three stages in each session.

The exploration phase consisted of the following components:

1. Stage I: The researcher asked the teachers to write down personal criteria to evaluate teaching performance before watching a tape.
2. Stage II: The teachers evaluated the teaching based on the personal criteria while watching the tape.
3. Stage III: The teachers grouped randomly, negotiated a set of criteria for evaluating teaching performance, and presented their group criteria.

At the final two tape-watching sessions, the teachers observed and kept records of the teaching strategies used, the classroom arrangement, the students' response, and how the teacher handled the students' responses. After watching

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each tape, the researcher conducted a whole-class discussion about the instructional strategies involved.

4. Stage IV: After the classes described above, the researcher picked one set of criteria randomly. The researcher announced that the criteria set is the best one and asked the teachers to memorize the criteria for a test. The in-service teachers got a couple minute to memorize the "knowledge."

II. the concept explanation phase:

The researcher used the designed activity as an analogy to explain the developing nature of scientific knowledge and the importance of preconceptions while constructing new knowledge. The researcher also introduced ideas about social construction of knowledge and learning cycle teaching approach.

III. the concept application phase:

The in-service teachers picked a concept and applied the teaching strategies learned from the previous phases, including the strategies used in the tapes and the learning cycle approach. They also had to consider the developing nature of scientific knowledge, in addition to teaching the scientific concepts.

Four months after the classes, the teachers described their understandings of constructivism in a questionnaire.

## DATA ANALYSIS

The worksheets collected was checked to see the similarity among criteria sets from each session.

The teachers' understandings of constructivism were analysized by the constant comparison method.

## FINDINGS

From the class discussions and presentations, it was found that the in-service teachers show positive attitudes toward this instructional strategy and initiated more discussion about constructivism. They agreed that the importance of the learners' preconceptions in learning science, however, they argued that time limitation and the awy the textbook was edited were barriers to adopt constructivist teaching approaches. With a better understanding about the epistemological status of the scientific knowledge, the teachers were more willing to incorporate history of science and group discussion into their teaching.

From the worksheets collected, it was found that most of the criteria listed were focus on teachers' traits, teaching behaviors associated with lecturing, scope and sequence of teaching content, and classroom management. The amount of criteria listed increased through the tape watching sessions. Besides, the teachers used almost identical phrases in stating criteria in the third tape-watching session.

From the questionnaires, it was found that the teachers described constructivism in terms of: (1) the importance of learners' preconceptions in science teaching, (2) learning is an active process, (3) learning involves conceptual change, and (4) knowledge is tentative and subject to change.

## SUGGESTIONS

From the findings described above, the researcher believes this introductory activity was successful. However, some follow-up activities, such as interviews and classroom observations will be necessary to derive further information about how to help these in-service teachers to incorporate various strategies into their teaching practice. Besides,

it is importance to be aware that if the activity designed was not based on the in-service teachers' ideas, the activity might not have been so popular; if the tapes were not well-chosen and sequenced, the effects might not be so obvious; and if the teachers were not sufficiently interacted with each other in the group discussions, the analog used might not be so appropriate.

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